

CLAIMS:

1. A method for cleaning a single workpiece, comprising the steps of:
forming a layer of a liquid on the workpiece, with the liquid heated to
a temperature above 25C; and
5 providing ozone into the environment around the workpiece with
ozone diffusing through the layer of liquid and chemically reacting with a
contaminant at the surface of the workpiece, to clean the workpiece.
2. The method of claim 1 wherein the layer of liquid is formed by
spraying the heated liquid onto the workpiece and by spinning the workpiece.
- 10 3. The method of claim 1 further including the step of placing the
workpiece into a disk-shaped process chamber.
4. The method of claim 3 wherein the process chamber has a volume
of 5-50 liters.
5. The method of claim 1 further including the step of placing the
15 workpiece into a process chamber and heating the process chamber, to indirectly
heat the workpiece.
6. The method of claim 1 wherein the layer of liquid is formed on a
down facing surface of the workpiece.
7. The method of claim 1 wherein the layer of liquid is formed on an up
20 facing surface of the workpiece.

8. The method of claim 1 further including the step of controlling the thickness of the layer of liquid on the workpiece by controlling a flow rate of liquid applied onto the workpiece.

9. The method of claim 1 further including the step of placing the
5 workpiece into a chamber and providing the ozone by injecting ozone gas into liquid and then delivering the liquid into the chamber.

10. The method of claim 1 further including the step of placing the workpiece into a chamber, and providing the ozone by supplying ozone gas into the chamber.

10 11. The method of claim 2 further including the step of rotating the workpiece about a vertical axis.

12. The method of claim 1 wherein the ozone is provided at a concentration of at least 12%.

13. The method of claim 1 further including the step of forming the liquid
15 layer at a thickness of 1-100 microns.

14. The method of claim 1 further including the step of forming the liquid layer by pulsed spraying.

15. The method of claim 1 further including the step of forming the liquid layer by spraying.

20 16. An apparatus for cleaning a workpiece, comprising:
a process chamber;

a support in the process chamber for holding a single workpiece;
an ozone source connecting into the process chamber;
one or more liquid outlets in the process chamber;
a source of liquid connecting to the liquid outlet in the process

5 chamber; and

a liquid heater associated with the source of liquid, for heating the
liquid.

17. The apparatus of claim 16 further including a chamber heater on or
in the process chamber, for heating the process chamber.

10 18. The apparatus of claim 16 further including a rotor, with the support
on the rotor, to allow rotation of the single workpiece.

19. The apparatus of claim 16 wherein the process chamber is disk-
shaped.

20. The apparatus of claim 16 wherein the liquid outlets include spray
15 nozzles.

21. An apparatus for cleaning a workpiece, comprising:
a process chamber;
support means in the process chamber for holding a single
workpiece;

20 ozone supply means for supplying ozone into the process chamber;
one or more liquid outlets in the process chamber;

a source of liquid connecting to the liquid outlet in the process chamber; and

liquid heating means for heating the liquid.